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# $\mathcal{TA}3$: Case-Based Intelligent Retrieval and Advisory Tool

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Intelligent information retrieval helps to find relevant information even when the query is not specified completely. However, finding a relevant knowledge is only a first step in using it. Case-based reasoning systems can be used to solve new problems based on retrieved information. This process is similar to human reasoning – if the current problem is similar to an already solved case, then its solution can be adapted and reused to solve a new problem.

Internet and information highways allow us to access a great amount of information. One of the main problems we face is how to control browsing through interconnected information repositories and not to become lost. Database systems are based on well-defined needs of a user – submitted query is complete and exact. In an information retrieval system user's needs are ill-defined in general – user knows what (s)he wants, yet is unable to specify query request completely.

In such a situation, more flexible retrieval tools are necessary. When specifying their needs, users find it easier to use examples than to specify queries precisely. It is easier to say: "Find all medical records that are similar to this particular case, but patient's age is not so important so it does not need to match closely" then to specify some 60 attribute/value pairs, describing particular medical case. Moreover, it is unlikely that there would be two identical medical cases in a database; thus, similarity-based retrieval needs to be utilized to find close matches. In our definition of similarity, context plays a central role. Context specifies what part of an information to consider and what matching criteria to use.

The results of system evaluation on IVF domain suggest that context-based retrieval is effective in case-based retrieval and diagnosis. After knowing only 8 attribute/value pairs, the system predicts values for the remaining attributes. Successful cases were used to suggest treatment; unsuccessful cases served as a warning. The accuracy of prediction can be used as measure of the retrieval effectiveness of the system – relevant cases provide for accurate predictions. Using a simple cross-validation (leave-one-out method) and averaging results over 20 random trials, a relative error that falls in the range of $0.15 \pm 0.09$ and $0.07 \pm 0.04$ with 95% confidence interval was determined for the experiment. The performance could be improved if the database contained additional important data needed for problem solving (if its informativeness was increased).

TA3 was also applied for the letter recognition task. Each letter was described by 17 attributes and values for which were based on 20 different fonts and each letter within these 20 fonts was randomly distorted to produce a database of 20,000 instances. We carried out a series of experiments, changing size of the case base as well as retrieval and adaptation strategies. Using only a 10% of all cases, performance of $80\% \pm 0.2011$, $85\% \pm 0.1742$, $95\% \pm 0.1001$ and 100% accuracy was observed. When using all instances, the performance improved to $90\% \pm 0.1461$, 100%, 100% and 100% accuracy. These results compare favorably to other machine learning techniques used on the same dataset.

Evaluation of the system on a robotic domain was targeted on prediction. Retrieved relevant items were used to predict a real value for an attribute with 95% confidence – after averaging from 60 random trials a relative error $0.056 \pm 0.009$ was observed. The result compares favorably to other machine learning algorithm applied to the same problem.

An evaluation of context-based retrieval was also performed on a small software repository. Performance evaluation in this domain is more subjective due to the subjectivity of relevance measure. This experiment demonstrated, however, how the added flexibility of the proposed system could be utilized to alter the system's performance from precision to recall-oriented, i.e., from requiring that no irrelevant cases are retrieved (system is allowed to miss some relevant cases) through to requiring that absolutely all relevant cases are retrieved (system is allowed to retrieve some irrelevant cases).